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Supplementation effect of bypass fat on production performance of lactating crossbred cows

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ABSTRACT

Lactating crossbred cattle (10) were randomly divided into 2 groups on the basis of milk yield (14–15 kg/day), day of calving (~50 days) to see the effect of bypass fat supplementation on nutrient utilization and production performance. Cows were fed wheat straw, concentrate mixture and green maize fodder in the control group and additional 300 g bypass fat was given in treatment group. Experimental feeding was continued up to 90 days after 2 weeks of adaptation. The average milk production and fat corrected milk yield per day was significantly higher in treatment group. Milk fat and total solids content were improved significantly in treatment group, whereas milk protein and solids-not-fat remained unaffected in both groups. The digestibility of nutrients except that of ether extract was comparable in both groups. Intake per kg of milk produced was lower in treatment group than the control group. Milk production efficiency was also significantly higher (30.22%) in bypass fat supplemented in comparison to the control group (27.03%). It was concluded that bypass fat supplementation @300 g/d/animal in medium producing crossbred cows significantly increased the milk production and fat corrected milk yield up to 15.61 and 24.01%, respectively, over the control group.

Key words: Bypass fat, Cow, Digestibility, Milk production

The technology of bypass fat protects the nutrient from degradation and biohydrogenation in rumen with increase in the energy density of the diet enabling the animals to meet their energy and essential fatty acid requirements expressing their milk production potential to the fullest extent (Krishna Mohan and Reddy 2009). Additional fat fed as bypass fat does not interfere with rumen fermentation process, but supplies more energy to the animal for more milk synthesis after being digested in abomasums and small intestine with absorption from the small intestine. This helps in increasing unsaturated fatty acid in milk which can produce softer butter and safer milk for human consumption especially for heart patients (Bobe *et al*. 2007, Garg *et al*. 2008). The present study was done to evaluate feeding of bypass fat on nutrient intake, nutrient digestibility, feed conversion efficiency and milk production performance in crossbred dairy cows and compare their performance with normal ration.

MATERIALS AND METHODS

Animals, diet and feeding schedule: Lactating crossbred cows (10) from the institute herd, with average milk yield of 14.5 kg, were randomly divided into 2 groups of 5 animals each on the basis of milk yield and lactation stage (~50 days). The study was conducted during the summer months of March to May for 90 days after the adaptation period of 2 weeks. The control animals fed green maize fodder with wheat straw as roughage source and concentrate mixture (consisting of maize, 29; barley, 5; GN cake, 20; mustard cake, 12; wheat bran, 20; deoiled rice bran, 11; mineral mixture, 2; salt, 1 part), as per requirement (NRC 2001) whereas experimental group fed additional 300 g bypass fat (commercial product). The roughage: concentrate ratio of the diet was tried to be maintained at 70: 30.

Lactation and digestion trial: The animals were kept in well-ventilated byres with access to fresh water and having separate mangers for fodder and concentrate. The animals were milked thrice a day at morning, noon and in evening and the concentrate (total quantity divided into 3 parts) was given at each milking time. Bypass fat was added and mixed in concentrate uniformly in morning and fed individually to each animal. Maize fodder was offered at 11: 00 h and wheat straw at 17: 00 h. Daily recording of milk yield and DM intake through different feeds was recorded for each animal. Milk samples from each animal in both groups were collected and analysed at weekly intervals for milk composition. In between the trial, a 7-day digestion trial was conducted to determine the intake and digestibility of nutrients.

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Analytical procedures: Pooled samples of dung, feeds and refusals were ground to pass through 1 mm sieve and analysed for proximate (AOAC 1990) and cell wall components (Goering and Van Soest 1970). During the whole trial period, the milk samples were collected and pooled in a container from all individual animals and analysed for milk protein, milk fat and solids-not-fat (ISI 1961). All the periodical data with regard to milk composition; body weight and digestion trial data were statistically analysed by paired't' test with SYSTAT 7.0 (1997).

RESULTS AND DISCUSSION

Composition and intake of nutrients: The chemical composition and fibre fractions of wheat straw and green maize were within the normal range (Table 1) with respect to different nutrients and fibre fractions (Ranjhan 1991). The ether extract content of bypass fat was 85%, indicating that the supplement was quite rich in energy content. Dry matter intake (DMI) was higher for treatment group compared to control (Table 2), however, the values were non-significant. The higher DMI may be due to additional bypass fat supplementation, which resulted in slight enhancement of concentrate intake and also changed the roughage concentrate ratio slightly, varying from 70.53: 29.47 in the control group to 65.02: 34: 98 in treatment group. Kumar and Thakur (2007), Naik *et al*. (2007) and Garg *et al*. (2008) had also observed similar level of nutrient intake after addition of bypass fat to the experimental animals when compared with the control ones. This may be due to fat supplementation, which is in the normal level-incorporated @ 5–6% of DMI in the ration of animals (Kumar *et al*. 2004).

Table 1. Chemical composition of feeds (% DM basis)

Parameters	Wheat Straw	Maize fodder	Concentrate	Bypass fat
OM	89.25	88.38	85.01	88.00
EE	0.52	3.25	4.50	85.00
CF	41.30	32.05	9.20	-
CP	3.50	7.88	21.88	-
NDF	80.60	67.50	30.90	-
ADF	49.00	40.90	15.50	-
HC	31.60	26.60	15.40	-
Total ash	10.75	11.62	14.99	12.00

Table 2. Voluntary feed intakes of lactating cows

Particulars	Control	Treatment group	Significance
Initial BW (kg)	414.41±33.68	368.02±16.79	0.253
Final BW (kg)	422.60±36.36	377.70±13.88	0.282
Avg. BW (kg)	418.51±23.40	372.86±10.39	0.265
DMI (kg/d/animal)			
Maize fodder	9.58	9.58	-
Wheat straw	0.94	0.94	-
Concentrate	4.39	5.38	-
Bypass fat	-	0.282	-
Total DMI	12.54±0.39	13.60±0.30	0.062
% DMI	3.07±0.24	3.64±0.16	0.089
DMI/BW$^{0.75}$ (g)	137.57±8.68	159.97±5.60	0.062
Roughage : concentrate	70.53: 29.47	65.02: 34.98	–

Nutrient utilization: The digestibility values for different nutrients showed similar values, except that of ether extract (Table 3). Kumar and Thakur (2007) and Naik *et al*. (2007) also reported increase in EE digestibility which can be attributed to high quality fat inclusion in the experimental groups when included at the level of 2.5% in the former case or 100–300 g per animal in the latter. Voigt *et al*. (2006) showed that digestibility of ether extract is improved with protected fat whereas digestibility values of DM and CP remained similar when included at 6.6% of DMI. The results of the digestibility trial showed that the feeding of bypass fat to crossbred lactating cows resulted in increase in the consumption of digestible nutrients (DM, CP and TDN), as compared to the control group, which could have a bearing on the lactational performance of the animals.

The initial variation in body weights among the groups was significantly different and this difference was uniformly maintained during the trial. This indicates that the extra energy supplied through the feeding of bypass fat supplement, was not utilized by the animal for body fat synthesis/ deposition, but it used the extra energy supplied to produce more milk.

Table 3. Intake and digestibility of different nutrients of lactating cows

Particulars	Control	Treatment group	Significance
Digestibility coefficients (%)			
DM	71.02±1.17	70.47±2.15	0.826
OM	72.10±1.20	71.55±2.09	0.827
CP	91.59±0.70	90.31±0.80	0.264
EE*	75.37±2.48	85.24±1.65	0.011
CF	62.61±1.79	60.22±2.56	0.465
NDF	63.67±0.97	60.16±4.79	0.493
ADF	57.95±1.94	55.43±2.60	0.462
Nutritive value			
DDMI (kg/d/animal)	8.91±0.34	9.57±0.27	0.162
DCPI* (kg/d/animal)	1.44±0.04	1.60±0.05	0.028
TDNI (kg/d/animal)	8.33±0.32	9.24±0.24	0.052
DCP %	11.52±0.23	11.80±0.23	0.411
TDN %	66.42±1.12	67.97±1.87	0.498

* Values in row are significant at $P < 0.05$.

Production efficacy and performance: Feeding of bypass fat resulted in significant ($P<0.01$) increase in milk yield and FCM yield (Table 4). Milk yield and FCM yield was increased by 15.61% and 24.01% in bypass fat fed group over the

Table 4. Milk production performance and over all composition of milk in cows

Particulars	Control	Treatment group	Significance
Avg. MY/animal (kg) **	11.40±0.38	13.18±0.16	<0.01
Average FCMY (kg/d) **	12.01±0.28	14.89±0.08	<0.01
Average fat (%) **	4.37±0.01	4.86±0.01	<0.01
Average protein (%)	3.07±0.07	3.05±0.04	0.811
Average SNF (%)	8.41±0.01	8.45±0.02	0.141
Overall MY/animal/ 90d (kg)	1026.00	1186.20	–
Overall FCMY/animal/ 90d (kg)	1080.79	1340.31	–
Percent increase in FCM yield	-	24.01	–
Percent increase in milk yield	-	15.61	–
Projected increase in 305 days (kg)	-	542.90	–

** Values in row are significant at P< 0.01.

control group. Similarly, Kumar and Thakur (2007), Naik *et al*. (2007) and Garg *et al*. (2008) also reported significant improvement of milk yield in ruminants. On the basis of 90 days lactation performance, the projected increase in milk yield worked out as 542.90 kg in 305 days for the treatment group supplemented with bypass fat @300 g/day over the control. Though the yields were lower than average yields during the whole period of experiment, the trend was similar, with control group showing the lower values.

The feed conversion efficiency of the lactating cross bred cows fed diets supplemented with bypass fat is given in Table 5. The overall milk production efficiencies were 27.07, and 30.22% for the control and treatment group respectively (P<0.01). DMI, CPI and TDNI kg/kg milk produced showed non-significant among the groups. DMI/kg FCM produced also showed non-significant variation. However, CPI and TDNI required kg FCM yield showed significant variation among the groups, the values being lowest in treatment and highest in the control group. Thus, the overall conversion of nutrients into milk was improved upon protected fat supplementation (Mishra *et al*. 2004, Garg *et al*. 2008).

Table 5. Feed conversion efficiency of milk production

Particulars	Control	Treatment group	Significance
Avg. MY/animal (kg)	11.40±0.38	13.18±0.16	<0.01
Average FCMY (kg/d)	12.01±0.28	14.89±0.08	<0.01
DMI/kg milk produced	1.10	1.03	NS
DMI/kg FCM (kg)	0.96	0.96	NS
CPI/kg milk produced	137.71	134.29	NS
CPI/kg FCM produced	130.72	118.87	*
TDNI/kg milk produced	730.70	701.06	NS
TDNI/kg FCM produced	693.59	620.55	*

*Values in row are significant at P< 0.05.

Milk composition

Milk fat percentage differed significantly (P<0.01) whereas milk protein and SNF were similar between experimental and the control groups (Table 4). Milk fat per cent showed a clear cut rise with the bypass fat supplementation (Mishra *et al*. 2004, Garg *et al*. 2008). However, milk protein level decreased in some experiments (Polidori *et al*. 1997). But, like this study milk protein level was similar in all other experiments. The study has made it amply clear that our medium and high producing lactating crossbred cows do need the bypass fat supplement in their diet incorporated, in order to meet their energy requirements fully to express their milk production potential. This was demonstrated by the highly significant increase in milk yield, FCM yield, fat percentage and TS percentage in milk as a result of feeding the bypass fat supplement (Table 4). Increase in unsaturated fat content of milk resulting in softer butter was obtained by feeding rumen protected fat resulting in more of unsaturated fatty acids in milk (Bobe *et al*. 2007, Garg *et al*. 2008).

Demand for energy is very high during early stage of lactation but supply of energy is not commensurate with demand due physiological stage or limited intake which affects total production potential of animal in whole lactation length. So, supplementation of bypass fat before parturition could reduce the detrimental effects of negative energy balance which could increase both lactation as well as metabolic performance (Duske *et al*. 2009). Improved energy balance could results in an earlier return to postpartum ovarian cyclicity (Palmquist and Jenkins 1980). Feeding of bypass fat also increases the blood cholesterol concentration which may affect plasma progesterone concentration and help in improving the fertility (Staples *et al*. 1998).

Our results showed that bypass or inert fat supplementation to medium and/or high producing (10–20 kg/day) lactating crossbred cows is beneficial in terms of increasing milk production and fat corrected milk yield particularly in early lactation. However, long term trial in different seasons and at various locations to confirm this claim.

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